



Technical Memorandum

Soil Vapor Extraction (SVE) System Operations Summary:

July 2005 through December 2005

**National Aeronautics and Space Administration,
Jet Propulsion Laboratory, Pasadena, California**

Final

January 23, 2006

The objective of this technical memorandum is to summarize the performance and assess the effectiveness of the soil vapor extraction (SVE) system operation for the period of July through December 2005. During this time period, the SVE system operated at vapor extraction well VE-03. The system effectiveness was evaluated based on volatile organic compound (VOC) concentration and mass extraction trends, as well as a comparison of VOC concentrations to the soil vapor screening levels (VSLs) calculated from the Regional Water Quality Control Board (RWQCB) 1996 *Interim Site Assessment and Cleanup Guidebook*.

INTRODUCTION

JPL was placed on the National Priorities List (NPL) in 1992. The Remedial Investigation/Feasibility Study (RI/FS) Work Plan identified the investigative work required to adequately characterize the chemicals in on-facility soil, Operable Unit 2 (OU-2). Investigative work identified in the RI/FS Work Plan consisted of installation and sampling of nested soil vapor monitoring wells. The sampling of these wells indicated the presence of VOC vapors, primarily carbon tetrachloride (CCl₄), Freon 113, and trichloroethene (TCE).

An SVE pilot study was initiated at VE-01 in April 1998 and was conducted in five phases through June 2001. The Record of Decision (ROD) for OU-2 was signed in September 2002 (National Aeronautics and Space Administration [NASA], 2002), specifying SVE as the remedial action. Three additional vapor extraction wells were installed and the SVE system was then operated at VE-03 from October 2002 through April 2003, at VE-04 from May 2003 through December 2003, and at VE-02 from April 2004 through October 2004.

In February 2005, the *SVE Progress Report and Optimization Evaluation* (NASA, 2005) was completed to evaluate the performance of the SVE system during the first operational period at each well and provide recommendations for optimizing future system operations. NASA concluded that VOC concentrations have been significantly reduced since startup of the system, and identified CCl₄ and TCE as the remaining chemicals of interest based on a comparison of the last one year of soil vapor monitoring data to the VSLs.

NASA also concluded that VOC mass loadings at two soil vapor monitoring locations within the area of influence of VE-03 could potentially result in leachate concentrations exceeding maximum contaminant levels (MCLs) in groundwater. In addition, VE-01 demonstrated the highest VOC mass extraction rates during the first operational cycle. Therefore, a second round of SVE operation was recommended at both VE-01 and VE-03. The SVE system was operated again at VE-01 from December 2004 through May 2005, and at VE-03 from June 2005 to September 2005.

Based on monitoring and performance data collected during the most recent operating cycles at VE-01 and VE-03, the remedial action performance objectives stated in the ROD have been achieved (NASA, 2005a). The SVE system was temporarily shut down on September 9, 2005, and rebound monitoring was initiated.

SVE SYSTEM DESCRIPTION

The existing SVE system consists of a skid-mounted extraction vacuum blower (20-hp motor), moisture separator (50-gallon knockout tank with sight glass, level switch, and safety interlock to shut down blower for high water level), four granular activated carbon (GAC) vessels (each containing 2,000 lb of vapor-phase GAC) in a series-parallel arrangement, and a dilution and recirculation air valve to regulate vacuum and flow. Other components include a flow meter for measuring flow, magnehelic gauges and U-tube manometers to measure vacuum and vacuum responses, a field flame ionization detector (FID), and vapor sampling equipment.

Vapors are removed from the soil by the vacuum blower and then pass through the moisture separator, in-line filter, and air mixing valve before entering the GAC vessels for treatment. The treated air/vapor is discharged to the atmosphere. The maximum flowrate of extracted soil vapor and ambient air combined is 500 cubic feet per minute (cfm). A process flow diagram for the SVE system is shown on Figure 1.

VE-03 is located in the vicinity of soil vapor monitoring wells Nos. 20, 22, and 32. VE-03 consists of two discrete screened intervals which are designated shallowest to deepest as VE-03-A and VE-03-B. Each casing is constructed of 2-inch-diameter Schedule 80 polyvinyl chloride (PVC) pipe, and is screened (0.020 inch slots) from 25 to 85 ft below ground surface (bgs) and 99 to 159 ft bgs, respectively. The location of the SVE wells and the soil vapor monitoring wells are shown in Figure 2.

SYSTEM PERFORMANCE SUMMARY

The SVE system was restarted at VE-03 on June 3, 2005, and operated with two screened intervals (VE-03-A and VE-03-B) through June 17, 2005. On June 17, 2005 the deeper screened interval was shut down, and the system operated with only VE-03-A to maximize VOC mass removal from this screened interval. On July 29, 2005 the shallower screened interval was shut down, and the system then operated with only VE-03-B to maximize VOC mass removal from the deeper screened interval.

During these first 2 weeks of operation, vapor sampling results indicated that the average VOC mass extraction rate from both screens was only 0.0012 lb/day. The average mass extraction rate remained nearly constant, 0.0009 lb/day, over the next 6 weeks of operation at VE-03-A. The average mass extraction rate increased somewhat during the final 6 weeks of operation at VE-03-B, but remained very low at only 0.0041 lb/day.

No system shut down periods were encountered during operation at VE-03. Site visits were made on a total of 67 days during the operating period for sample collection, operation and maintenance, and system optimization. While operating both screens at VE-03, the flowrate

averaged approximately 330 cfm, at an average applied wellhead vacuum of 85 inches of water. While operating only VE-03-A, the flow rate was approximately 330 cfm at an applied wellhead vacuum of 78 inches of water, and at VE-03-B the flow rate was approximately 290 cfm at an applied wellhead vacuum of 82 inches of water.

The following SVE system parameters were recorded manually during each site visit: (1) vacuum induced by the extraction blower; (2) water level in the mist eliminator; (3) vacuum at each individual screened interval; (4) vapor flowrate at each individual screened interval and the influent; (5) flame ionization detector (FID) readings at the influent and effluent; and (6) vacuum responses in soil vapor monitoring wells. The SVE system operating parameters monitoring records are included in Appendix A. A summary of extraction well operating parameters, flowrates, and FID readings are shown in Table 1, and vacuum responses in soil vapor monitoring wells in Table 2.

SVE system influent and effluent (stack) vapor samples were collected in accordance with the South Coast Air Quality Management District (SCAQMD) permit conditions. Each sample was analyzed for VOCs using an FID calibrated to hexane, as required by the SCAQMD. In addition, the SVE system influent, effluent, and individual screened interval vapor samples were collected once every two weeks over the duration of the SVE operation for laboratory analyses. In order to evaluate VOC concentrations during startup and to select optimal operating conditions, the SVE system influent, effluent, and individual screened interval vapor samples were collected four times during the first week of system startup for laboratory analyses. All samples for laboratory analysis were shipped under chain-of-custody via Federal Express to Air Toxics Ltd. (an environmental analytical laboratory in Folsom, California). The samples were analyzed for VOCs by United States Environmental Protection Agency (U.S. EPA) Method TO-14. Laboratory data packages are presented as Appendix B. A summary of laboratory analytical results is presented in Table 3.

During operation of VE-03, the influent CCl₄ and TCE concentrations ranged from non-detect to 0.140 µg/L and from non-detect to 0.170 µg/L, respectively. The highest VOC influent concentrations were observed during operation of screen VE-03B. The influent and effluent emission rate calculations for VE-03 are shown in Table 4. The emission rates were within the permit requirements set by the SCAQMD. During operation of VE-03, the SVE system has achieved 100% removal efficiency for CCl₄ and PCE, and greater than 80% removal efficiency for TCE.

The “maximum” radius of influence (ROI) is determined by the maximum distance in the soil from the test well that is affected by the vacuum applied to the well (i.e., where the vacuum dissipates to zero). During operation of VE-03, vacuum responses were observed in the soil vapor monitoring wells (No. 38 and 39) as far as 1,400 ft from the extraction well. The “effective” ROI is the distance from the test well where the vacuum in the soil is equal to a percentage of the vacuum applied to the well (usually assumed to range between 1 and 5 percent). For operation of the SVE system the effective ROI is calculated at 5% of wellhead vacuum. In VE-03, the average vacuum applied to the well was 80 inches of water; therefore, the effective ROI was approximately 500 ft based on an observed vacuum in the soil of 4.0 inches of water.

SYSTEM EFFECTIVENESS EVALUATION

The performance objectives outlined in the ROD for OU-2 (NASA, 2002) include: (1) VOC concentration reduction; (2) asymptotic mass removal; and (3) cost-effective system operation. Each performance objective is evaluated below for the VE-03 operating period (June through September 2005).

VOC Concentration Reduction

Table 5 presents a comparison of the SVE system influent and extraction well screen data to the RWQCB VSLs. In addition, well screen data and VSLs are depicted on Figures 3 and 4. These figures show that the CCl₄ and TCE concentrations remained very low throughout the operating period. None of the extracted CCl₄ or TCE vapor concentrations exceeded the VSLs in VE-03.

A site-wide soil vapor monitoring event was completed in October-November 2005 after the SVE system was temporarily shut down. Tables 6 and 7 present a comparison of CCl₄ and TCE concentrations from soil vapor monitoring wells prior to SVE operations, during the final year of SVE operations, and post-SVE operations. Data is presented for all soil vapor monitoring wells in which CCl₄ or TCE concentrations were detected prior to SVE operation (1998-1999), and where samples were collected during the latest October-November 2005 sampling event.

This comparison shows that operation of the SVE system has significantly decreased the VOC concentrations throughout the site and no initial signs of concentration rebound have been identified. There is only one location where the post-SVE TCE concentration is slightly greater than the pre-SVE concentration (well 39-100). However the post-SVE concentration (1.9 µg/L) is below the respective VSL for this location (4.8 µg/L).

Soil vapor monitoring data collected during the past year were also used to calculate the remaining mass of CCl₄ and TCE in the soil. The mass estimates were calculated using a three-dimensional computer modeling software package, EarthVision™ Volumetrics program. Table 8 summarizes the historical and recent mass estimates for CCl₄ and TCE. Based on the most recent mass estimates, the SVE system has removed approximately 99% of the CCl₄ and 60% of the TCE mass from the soil.

Asymptotic Mass Removal

The influent VOC concentrations were combined with flowrate data to calculate mass of VOCs removed from the subsurface per day. Mass extraction rates during the first operational cycle at each vapor extraction well were lowest from VE-03. The CCl₄ and TCE mass extraction rates were 0.004 lb/day and 0.006 lb/day during the October 2002 through April 2003 operating period. During the most recent VE-03 operating period (June to September 2005), the average mass extraction rates were much lower, only 0.0007 lb/day for CCl₄ and 0.002 lb/day for TCE. A graph showing cumulative CCl₄ and TCE mass extracted since startup of the SVE system in 1998 is included as Figure 5.

Cost-Effectiveness

Due to the decreasing VOC mass removal data, the SVE system is becoming less cost-effective to operate. During the first operational cycle at VE-03, the average cost per pound of VOC removed was approximately \$100,000; however, during the current operational period the average cost has increased to approximately \$600,000 per pound of VOC removed. Figure 6 shows the average cost per pound of VOC removed by the SVE system since startup in 1998. The average cost of VOCs removed actually decreased during this last operating period at VE-03; however, this apparent decrease in cost is due to a very small increase in the average VOC mass extracted when operating screen VE-03-B (0.0041 lb/day) compared to screen VE-03-A (0.0009 lb/day). Overall, the average cost for VOC mass removal was higher during this operating period at VE-03 than any other previous operating period.

CONCLUSIONS

Overall, VOC concentrations have significantly decreased during the second operation period at VE-03. No exceedances of either the CCl₄ or the TCE VSLs were identified during operation of VE-03. In addition, CCl₄ and TCE mass extraction rates during the recent SVE system operation at VE-03 are significantly less than the mass extraction rates achieved during the first operational cycle at this extraction well, causing operation of the system to become much less cost-effective. Based on this information, the SVE system was temporarily shut down following completion of the operating period at VE-03 on September 9, 2005, and rebound monitoring has been initiated as the first step to site closure.

REFERENCES

- National Aeronautics and Space Administration (NASA). 2002. *Record of Decision and Remedial Action Plan for Operable Unit 2, National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California.* September.
- National Aeronautics and Space Administration (NASA). 2005a. "Technical Memorandum, Operable Unit 2 System Shutdown and Rebound Monitoring, National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California." November.
- National Aeronautics and Space Administration (NASA). 2005b. *Soil Vapor Extraction Progress Report and Optimization Evaluation, Operable Unit 2, National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California.* February.
- Regional Water Quality Control Board (RWQCB). 1996. *Interim Site Assessment & Cleanup Guidebook.* California Regional Water Quality Control Board - Los Angeles Region. May.

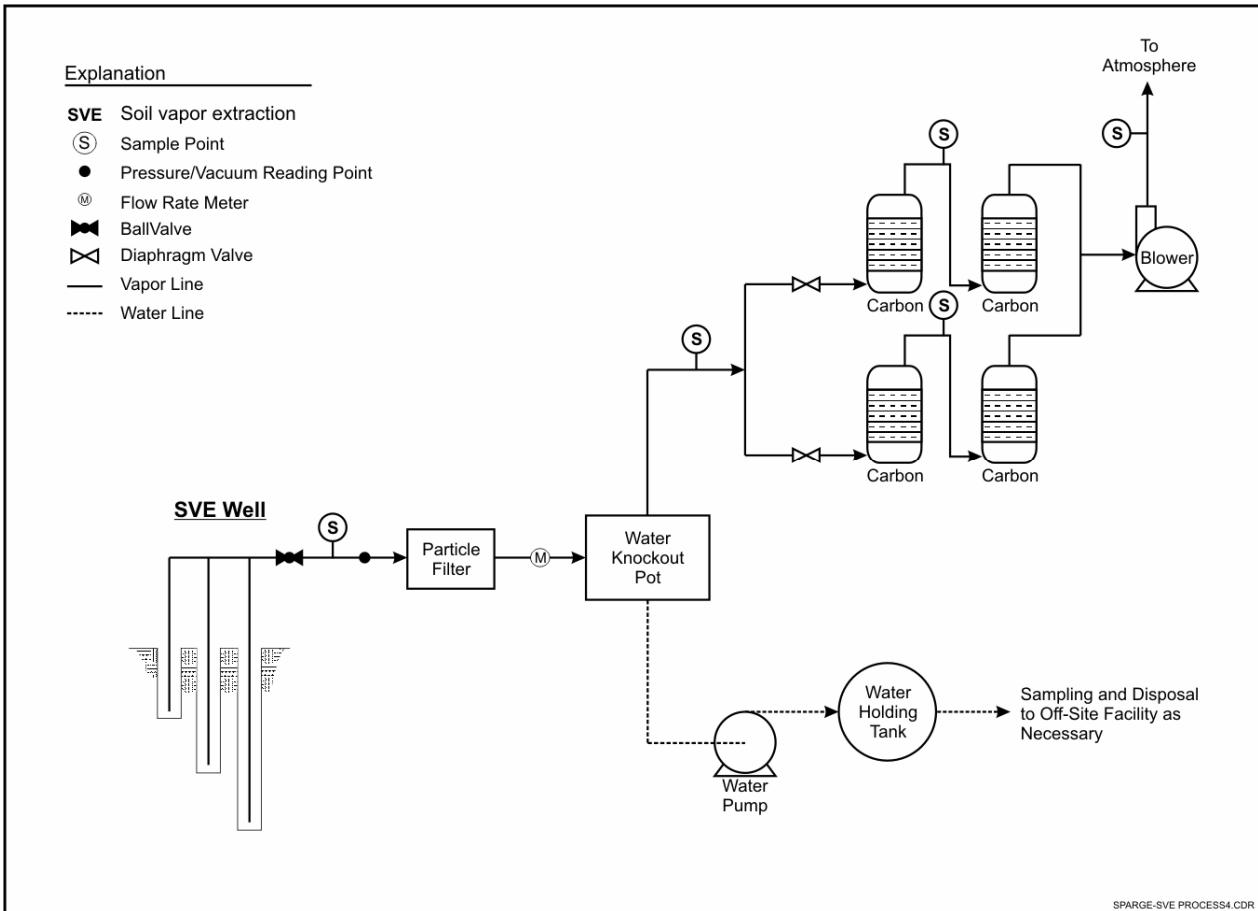


Figure 1: SVE Process Flow Diagram

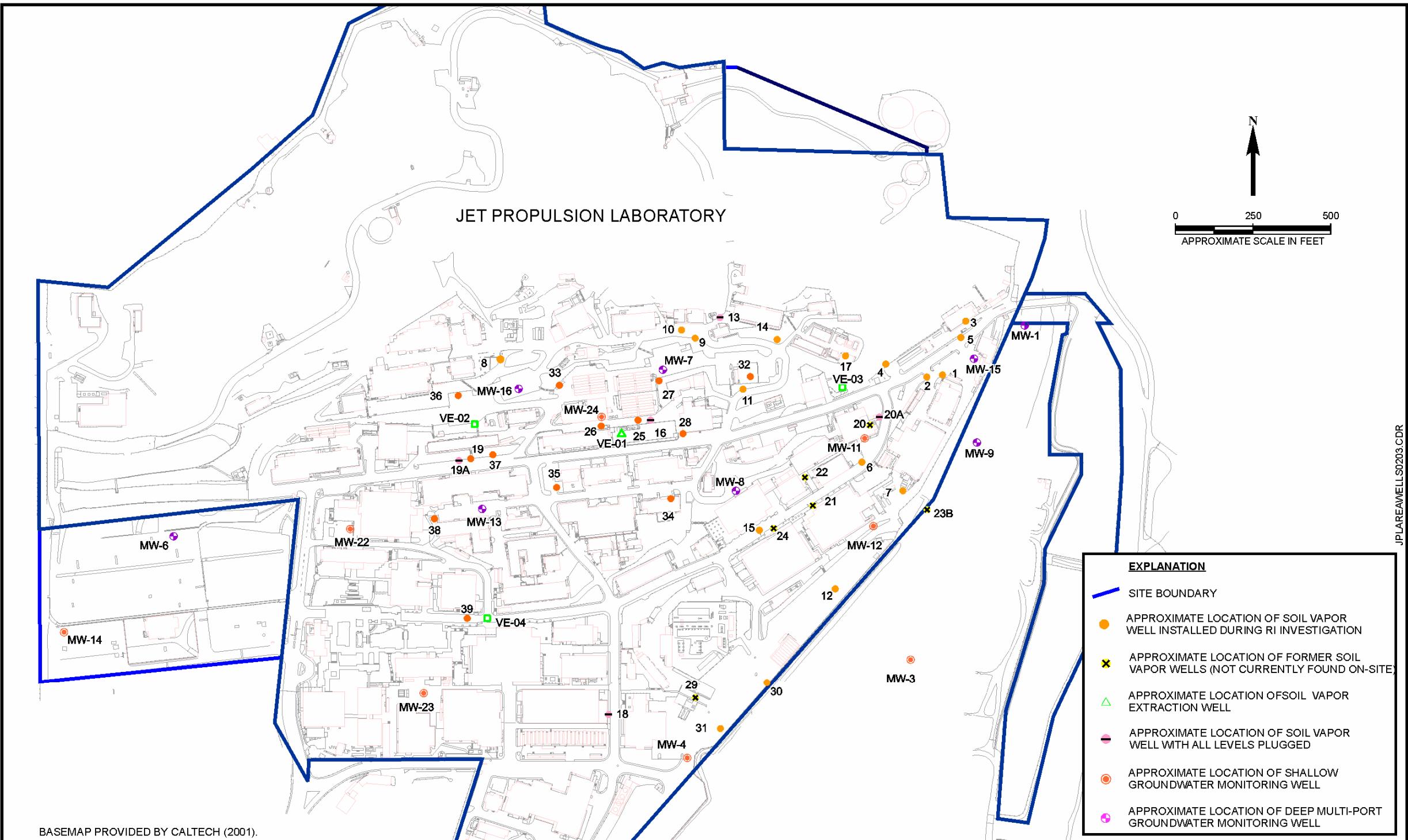


Figure 2: SVE Well and Soil Vapor Monitoring Well Locations

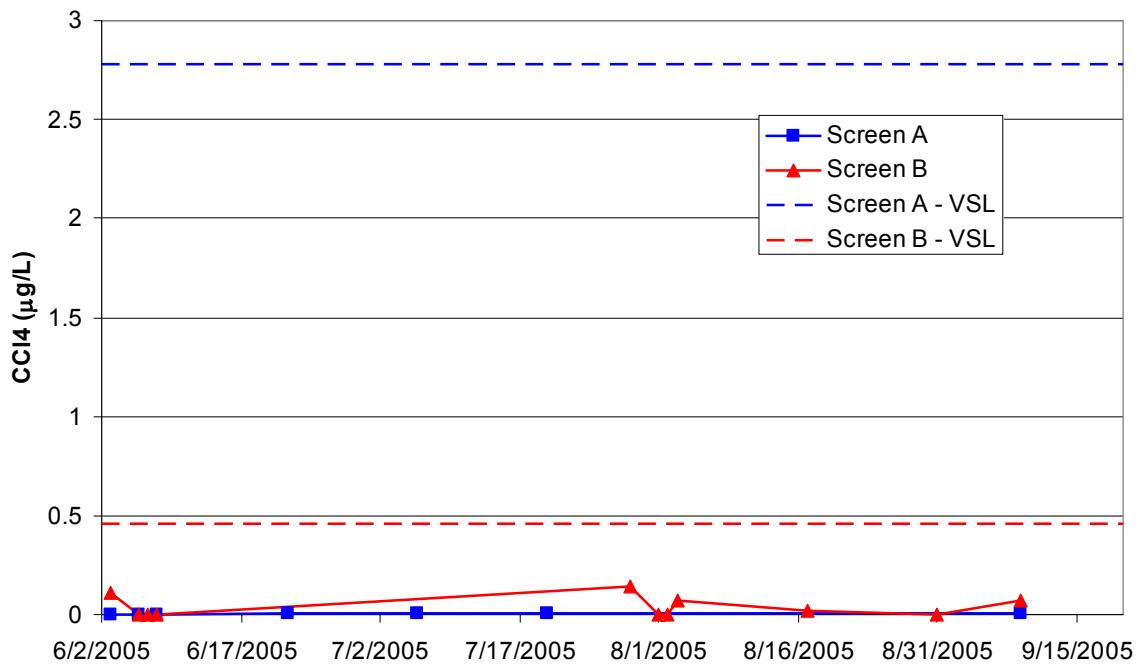


Figure 3: VE-03 CCl_4 Concentrations, June – September 2005

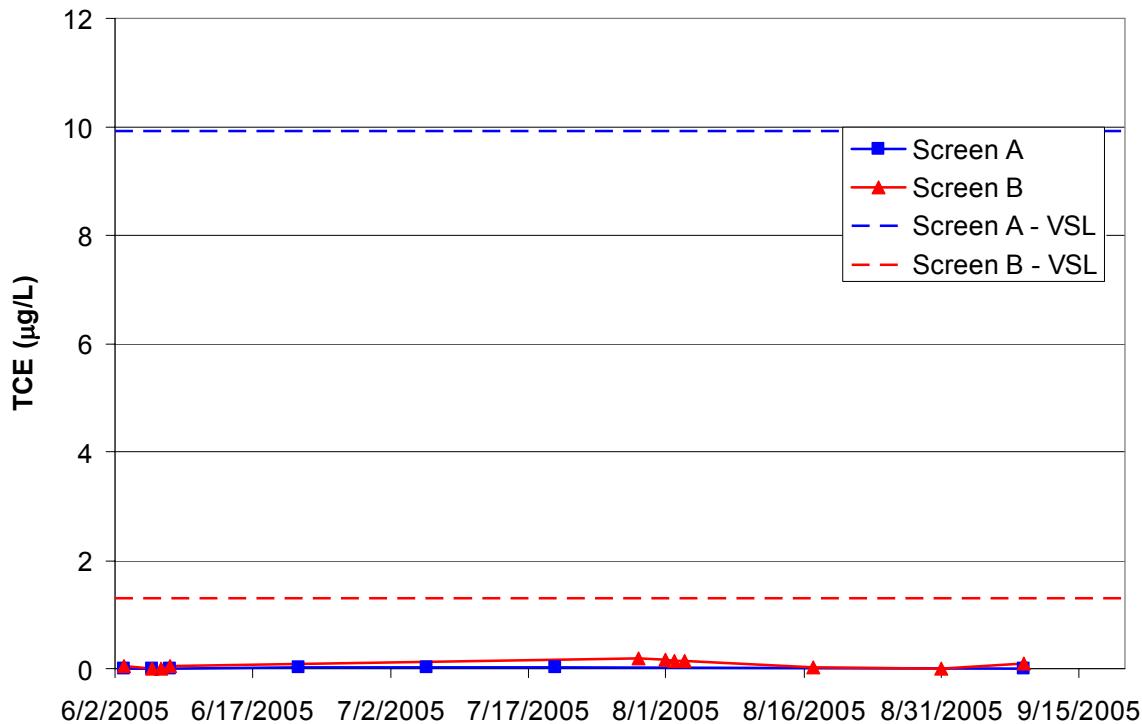


Figure 4: VE-03 TCE Concentrations, June – September 2005

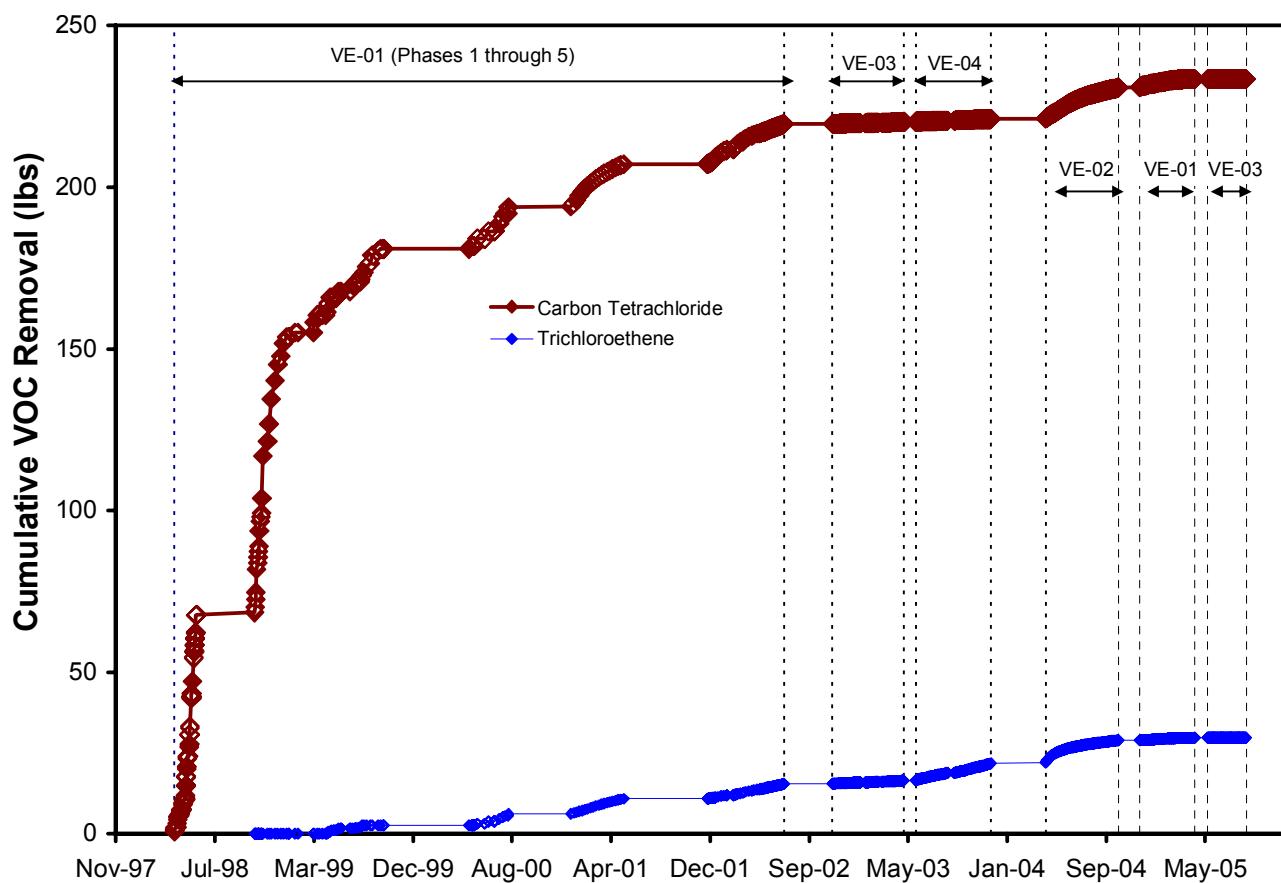


Figure 5: Cumulative CCl_4 and TCE Mass Removal

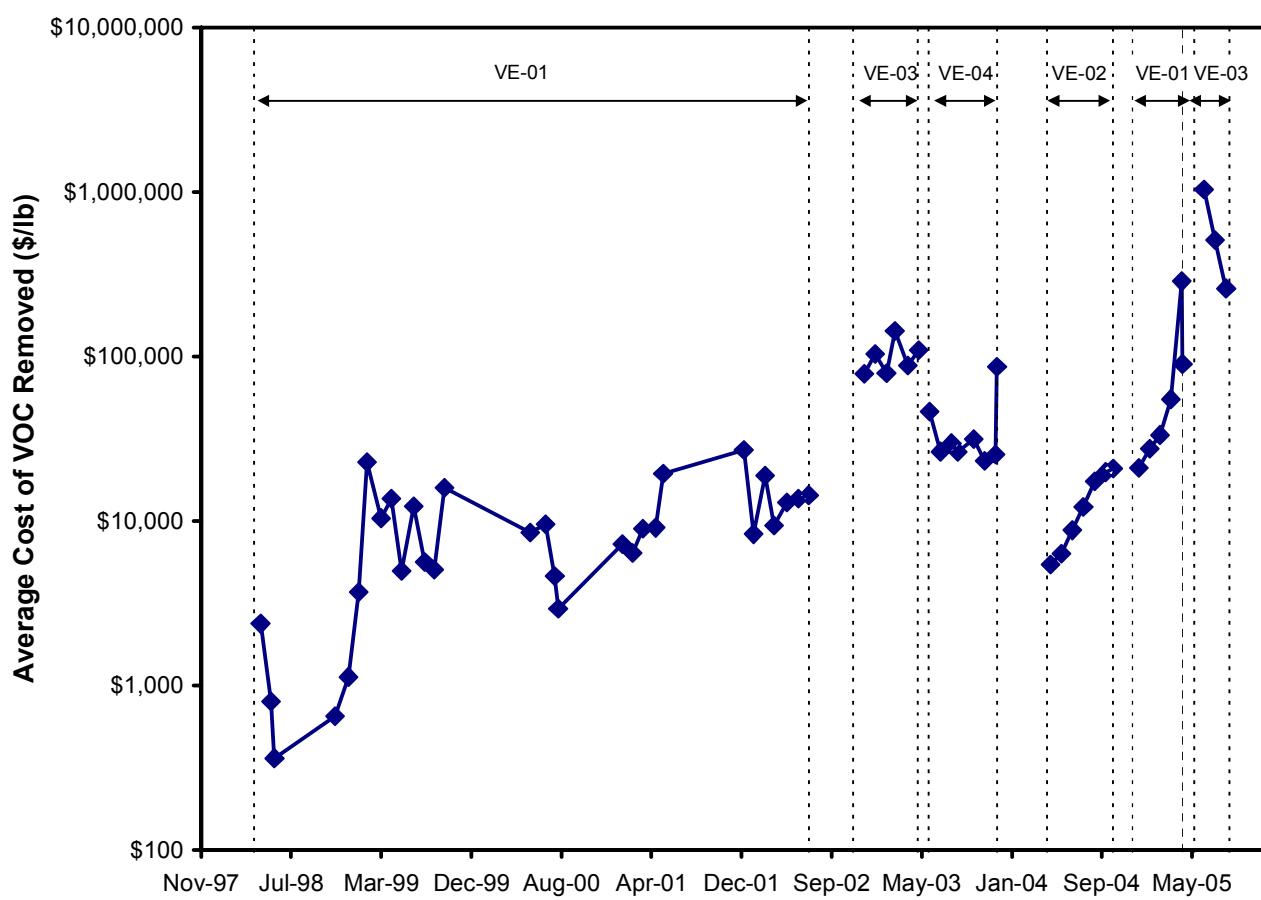


Figure 6: Average Cost per Pound VOC Removed

Table 1: System Monitoring Data (Vacuum, Flowrate and FID Readings)

WEEK	DATE	TIME hours	WELL SCREEN	VACUUM			Total Influent in.H ₂ O	FLOWRATE				FID READINGS			
				ANEMOMETER FLOWRATE		Flowmeter Influent scfm		LCD Reading Influent cfm	Influent (A) ppm	Influent (B) ppm	Influent (Total) ppm	Effluent (Total) ppm			
				A ft/m	B ft/m										
VE-03															
1	6/3/2005	1303	AB	64	63	80	15000+	5123	288	346	6.4	24	6	10	
	6/3/2005	1435	AB	64	63	80	15000+	6705	288	346					
2	6/6/2005	626	AB	66	65	85	10680	3061	288	362					
	6/6/2005	754	AB	67	65	85	11053	3441	288	340					
	6/6/2005	931	AB	67	66	85	12591	3809	288	352					
	6/6/2005	1130	AB	67	66	85	13508	4491	288	334					
	6/6/2005	1232	AB	66	65	85	15000+	4595	288	318	4	15	6	5.2	
	6/7/2005	618	AB	66	65	85	1477	3014	288	354					
	6/7/2005	751	AB	67	66	85	11133	3534	288	336					
	6/7/2005	917	AB	67	66	85	11546	3335	288	322	5	9	6.2	5.5	
	6/7/2005	1100	AB	67	66	85	15000+	4280	288	338					
	6/7/2005	1235	AB	67	65	85	15000+	4930	288	306					
	6/8/2005	622	AB	67	67	85	9810	2801	288	329					
	6/8/2005	1243	AB	66	66	85	15000+	3968	288	308	5	11	5.6	5.2	
	6/8/2005	1415	AB	66	66	85	15000+	5969	288	301					
	6/9/2005	633	AB	68	66	85	10908	301	288	368					
	6/9/2005	757	AB	68	66	85	11320	4390	288	345					
	6/9/2005	938	AB	68	66	85	15000+	4567	288	311					
	6/9/2005	1107	AB	68	66	85	15000+	4232	288	309					
	6/9/2005	1240	AB	67	66	85	14278	4579	288	308	4.2	12.5	5.5	5	
3	6/10/2005	715	AB	67	66	85	11463	3375	288	347					
	6/10/2005	917	AB	67	66	85	13988	3498	288	330					
	6/10/2005	1200	AB	67	66	85	15000+	4502	288	318	4.3	14.8	5.5	5.2	
	6/13/2005	634	AB	68	66	85	1481	3271	288	358					
	6/13/2005	803	AB	68	66	85	11912	4041	288	326					
	6/13/2005	928	AB	68	66	90	15000+	4070	288	318					
	6/13/2005	1140	AB	67	66	90	15000+	5980	288	321	4.2	30.2	6.2	5.6	
	6/13/2005	1307	AB	66	65	90	15000+	5214	288	336					
	6/14/2005	923	AB	68	67	88	13662	4572	288	318					
	6/14/2005	1130	AB	67	66	88	15000+	4908	288	329					
	6/14/2005	1434	AB	66	65	81	15000+	8760	288	319	4.4	20	7.2	9.1	
	6/15/2005	830	AB	68	67	87	12751	3262	280	340	4	12	5.5	6.5	
	6/15/2005	1239	AB	67	66	86	15000+	4563	288	311					
	6/15/2005	1415	AB	66	66	88	15000+	12900	288	321					
	6/16/2005	830	AB	68	67	88	12382	3520	300	324	4.1	18	6.2	7	
	6/16/2005	1047	AB	68	67	88	14296	4698	288	337					
	6/16/2005	1216	AB	68	67	88	14590	4563	288	314					
	6/16/2005	1429	AB	67	66	88	15000+	7573	288	317					
	6/17/2005	953	A	54		70	11654		270	376	4.4		4.6	5.1	

Table 1: System Monitoring Data (Vacuum, Flowrate and FID Readings)

WEEK	DATE	TIME	WELL SCREEN	VACUUM		Total Influent in.H ₂ O	FLOWRATE		FID READINGS					
				VE-03-A in. H ₂ O	VE-03-B in. H ₂ O		ANEMOMETER FLOWRATE		Flowmeter Influent ft/m	LCD Reading Influent scfm	Influent (A) ppm	Influent (B) ppm	Influent (Total) ppm	
							A ft/m	B ft/m						
3	6/17/2005	1121	A	54		70	11287		266	366				
	6/17/2005	1429	A	54		70	15000+		240	348				
4	6/20/2005	815	A	54		70	11320		228	357	5	6.3	6.2	
	6/20/2005	1016	A	54		70	12591		240	352				
	6/20/2005	1221	A	54		70	15000+		240	338				
	6/20/2005	1423	A	55		70	15000+		240	349				
	6/21/2005	806	A	54		70	10908		228	356	5.2	7	6.4	
	6/21/2005	1004	A	62		80	13347		240	331				
	6/21/2005	1158	A	60		80	15000+		240	338				
	6/21/2005	1442	A	60		80	15000+		240	342				
	6/22/2005	848	A	60		80	15000+		228	351				
	6/22/2005	1058	A	60		80	15000+		240	342	5.4	6.9	5.6	
	6/22/2005	1420	A	58		80	15000+		240	339				
	6/23/2005	815	A	60		80	11775		240	359				
	6/23/2005	958	A	62		80	12517		240	324	5.5	6.1	6.5	
	6/23/2005	1236	A	60		80	13865		240	315				
	6/23/2005	1434	A	60		80	15000+		240	322				
	6/24/2005	830	A	60		80	1197		240	342	5.1	6.1	6.9	
	6/24/2005	1041	A	60		80	12471		240	335				
	6/24/2005	1215	A	60		80	15000+		240	332				
	6/24/2005	1423	A	59		80	15000+		240	347				
5	6/27/2005	827	A	61		80	10786		260	346	6	6.7	6.6	
	6/27/2005	1020	A	61		80	12315		240	324				
	6/27/2005	1410	A	60		80	13254		252	337				
	6/28/2005	830	A	61		80	11342		260	342	5.5	6.2	6.5	
	6/28/2005	1237	A	60		80	13326		260	329				
	6/28/2005	1437	A	60		80	13835		260	330				
	6/29/2005	902	A	61		80	12315		264	337	5.9	6.7	7	
	6/29/2005	1104	A	61		80	13784		264	351				
	6/29/2005	1321	A	60		80	15000+		264	341				
	6/30/2005	827	A	61		80	12257		240	335	5.7	6.6	7	
	6/30/2005	1052	A	61		80	12386		240	324				
	6/30/2005	1244	A	60		80	15000+		264	333				
	6/30/2005	1425	A	60		80	15000+		264	338				
	7/1/2005	826	A	61		80	11450		264	354	5.9	6.6	6.7	
	7/1/2005	1030	A	61		80	12659		264	332				
	7/1/2005	1238	A	60		80	15000+		264	322				
6	7/5/2005	816	A	61		80	13316		240	336	6	6.5	7.1	
	7/5/2005	1031	A	62		80	13385		264	317				
	7/5/2005	1227	A	60		80	13326		264	305				
	7/5/2005	1451	A	60		80	15000+		264	322				
	7/6/2005	830	A	61		80	12663		240	331				

Table 1: System Monitoring Data (Vacuum, Flowrate and FID Readings)

WEEK	DATE	TIME hours	WELL SCREEN	VACUUM		Total Influent in.H ₂ O	FLOWRATE		FID READINGS						
				VE-03-A in. H ₂ O	VE-03-B in. H ₂ O		ANEMOMETER FLOWRATE		Flowmeter Influent ft/m	LCD Reading Influent scfm	Influent (A) ppm	Influent (B) ppm	Influent (Total) ppm		
							A ft/m	B ft/m							
6	7/6/2005	1121	A	61		80	15000+		264	332	4.5		6.1	5.6	
	7/6/2005	1419	A	60		80	13804		264	329					
	7/7/2005	1148	A	61		80	13346		264	307	4.9		6.5	8.7	
	7/7/2005	1425	A	60		80	15000+		264	323					
	7/8/2005	801	A	61		80	12447		264	336	4.8		5.2	6.1	
	7/8/2005	1117	A	61		80	12667		264	340					
	7/8/2005	1422	A	60		80	15000+		264	326					
7	7/13/2005	1309	A	60		77	15000+		264	336	5.8		7.6	14	
	7/13/2005	1457	A	60		80	15000+		264	327					
	7/14/2005	827	A	61		80	14155		264	336	4.3		5.4	8.1	
	7/14/2005	1304	A	59		80	15000+		264	339					
	7/14/2005	1510	A	59		80	15000+		264	329					
	7/15/2005	728	A	60		80	12603		264	327	4.2		5.1	5.5	
	7/15/2005	1158	A	60		80	15000+		264	330					
8	7/18/2005	632	A	61		80	13210		264	329					
	7/18/2005	1422	A	60		80	15000+		264	340	4.6		7	6.2	
	7/19/2005	649	A	61		80	13036		264	336	4.5		5.5	5.2	
	7/20/2005	641	A	61		80	13518		264	321	4.2		5.5	5	
	7/20/2005	1547	A	60		80	12650		264	341					
	7/21/2005	656	A	62		80	14431		264	309	4		6.3	5.2	
	7/22/2005	643	A	61		80	13855		264	315	3.8		4.5	5.5	
9	7/25/2005	649	A	62		80	15000+		264	286	5		5	6.2	
	7/25/2005	1655	A	61		80	15000+		264	303					
	7/26/2005	650	A	62		80	13559		264	287	3.8		4.2	5.5	
	7/26/2005	1703	A	60		80	13254		264	302					
	7/27/2005	732	A	62		80	14056		264	306	4		4.6	5.5	
	7/27/2005	1407	A	60		80	15000+	12403	264	303					
	7/28/2005	647	A	62	64	80		4965	264	290	3.8		4.5	5	
10	7/29/2005	1226	B		64	80		5070	202	304	14		8.2	6.7	
	7/29/2005	1350	B		64	80			202	300					
	8/1/2005	645	B		64	80			5154	96	280		12	6	6
	8/1/2005	1733	B		63	80			4741	96	307				
	8/2/2005	654	B		70	85			4469	96	303		9	5.8	5.2
	8/2/2005	1500	B		69	85			5842	96	324				
	8/3/2005	706	B		70	85			4537	94	301		8	5.5	4.5
10	8/3/2005	1511	B		68	85			7166	94	328				
	8/4/2005	705	B		70	85			4780	94	284	13		6	4.9
	8/4/2005	1304	B		70	85			4554	94	304				
	8/5/2005	707	B		70	85			5378	94	276				
	8/5/2005	1040	B		70	90			7807	94	279				
	8/5/2005	1233	B		70	90			6055	94	311	15		9.6	8.5

Table 1: System Monitoring Data (Vacuum, Flowrate and FID Readings)

WEEK	DATE	TIME	WELL SCREEN	VACUUM		Total Influent in.H ₂ O	FLOWRATE		FID READINGS					
				VE-03-A in. H ₂ O	VE-03-B in. H ₂ O		ANEMOMETER FLOWRATE		Flowmeter Influent ft/m	LCD Reading Influent scfm	Influent (A) ppm	Influent (B) ppm	Influent (Total) ppm	
							A ft/m	B ft/m						
11	8/5/2005	1407	B		70	90		7614	94	288				
	8/8/2005	629	B		70	85		6688	94	291				
	8/8/2005	740	B		70	85		5196	94	285				
	8/8/2005	909	B		70	90		5448	94	265	13.5	7.4	7.2	
	8/8/2005	1030	B		70	90		4890	94	269				
	8/8/2005	1200	B		70	90		5865	94	306				
	8/9/2005	650	B		70	85		5364	94	294	10.5	6.2	5.5	
	8/9/2005	1319	B		70	85		4331	94	307				
	8/10/2005	648	B		70	85		4111	94	275	11	5.8	5.5	
	8/10/2005	1338	B		68	85		5976	94	290				
	8/11/2005	645	B		70	85		4789	240	292	13.5	5.5	5.5	
	8/11/2005	1410	B		68	85		5451	96	308				
	8/12/2005	637	B		70	85		4728	94	293	10	5.3	5.5	
	8/12/2005	1033	B		70	85		4972	94	287				
12	8/15/2005	654	B		68	85		4567	94	278	10	5.5	5	
	8/15/2005	1700	B		68	85		5652	94	308				
	8/16/2005	642	B		69	85		4120	336	279	10.2	5.5	5.5	
	8/16/2005	1319	B		68	85		4454	94	224				
	8/17/2005	802	B		69	85		4362	240	277				
	8/17/2005	1005	B		70	85		4563	96	266	7.1	7.2	5.7	
	8/17/2005	1137	B		70	85		5304	96	279				
	8/18/2005	815	B		70	88		4303	144	288	13	5	5.5	
	8/18/2005	1000	B		70	89		4972	144	267				
	8/18/2005	1200	B		69	89		6505	96	277				
	8/19/2005	1206	B		68	85		6667	94	242				
	8/19/2005	1333	B		68	85		7941	94	218	15	6.8	9.3	
13	8/22/2005	1307	B		60	80		5650	94	231				
	8/22/2005	1448	B		60	80		5432	94	271				
	8/23/2005	1343	B		60	75		5136	94	293	20	7.4	11	
	8/24/2005	623	B		60	80		3994	94	298				
	8/24/2005	940	B		62	80		4668	340	252	10	4.8	6.5	
	8/24/2005	1135	B		60	80		5184	144	314				
	8/25/2005	840	B		61	80		5474	288	294	10.1	5.7	5.6	
	8/25/2005	1007	B		62	80		5844	240	286				
	8/25/2005	1134	B		60	80		6801	94	302				
	8/26/2005	808	B		61	80		5665	360	289	12	5.6	6.1	
	8/26/2005	1215	B		60	80		5723	94	303				
	8/26/2005	1401	B		60	80		5959	94	309				

Table 1: System Monitoring Data (Vacuum, Flowrate and FID Readings)

WEEK	DATE	TIME hours	WELL SCREEN	VACUUM			Total Influent in.H ₂ O	FLOWRATE			FID READINGS					
				VE-03-A in. H ₂ O	VE-03-B in. H ₂ O			ANEMOMETER FLOWRATE		Flowmeter Influent scfm	LCD Reading Influent cfm	Influent (A) ppm	Influent (B) ppm	Influent (Total) ppm	Effluent (Total) ppm	
								A ft/m	B ft/m							
14	8/29/2005	920	B		58	75		7368	256	320		29	7.1	12		
	8/29/2005	1128	B		58	75		6209	94	343						
	8/29/2005	1318	B		57	75		6178	94	336						
	8/30/2005	815	B		59	80		5931	372	306		10.2	6.1	8		
	8/30/2005	1048	B		59	80		4915	94	305						
	8/30/2005	1253	B		57	75		5203	94	334						
	8/31/2005	637	B		58	75		4525	504	326		7.6	5.5	5.5		
	8/31/2005	924	B		60	80		4303	360	316						
	8/31/2005	1311	B		58	80		3925	240	304						
	9/1/2005	916	B		60	80		4701	396	316		10.1	6.1	8.1		
	9/1/2005	1047	B		60	80		4903	94	304						
	9/2/2005	942	B		61	80		4703	336	282						
	9/2/2005	1249	B		58	80		7650	94	316		25	7.2	12		
15	9/6/2005	851	B		61	80		4771	432	282		10.1	8.7	9		
	9/6/2005	1024	B		60	80		4743	94	271						
	9/6/2005	1217	B		58	80		5840	94	299						
	9/7/2005	856	B		60	80		4319	408	310		10	5.4	8.5		
	9/7/2005	1032	B		60	80		4802	94	296						
	9/7/2005	1253	B		58	80		5319	94	275						
	9/8/2005	854	B		60	80		5554	420	302		9	5.5	5.9		
	9/8/2005	1302	B		59	80		5722	94	294						
	9/9/2005	1132	B		59	80		4990	336	304		6.4	5.7	5.3		
	9/9/2005	1240	AB	60	60	80	12508	4797	396	285						

Table 2: Vacuum Responses in Soil Vapor Monitoring Wells

WEEK	DATE	SAMPLE PROBE ID	VACUUM RESPONSES (<i>Magnahelic Gauges</i>)											
			SVW-10 <i>in. H₂O</i>	SVW-12 <i>in. H₂O</i>	SVW-15 <i>in. H₂O</i>	SVW-27 <i>in. H₂O</i>	SVW-28 <i>in. H₂O</i>	SVW-33 <i>in. H₂O</i>	SVW-34 <i>in. H₂O</i>	SVW-35 <i>in. H₂O</i>	SVW-36 <i>in. H₂O</i>	SVW-37 <i>in. H₂O</i>	SVW-38 <i>in. H₂O</i>	SVW-39 <i>in. H₂O</i>
VE-03														
2	6/10/2005	A	P	NR	P	0	0.1	0	P	P	0	P	P	0
		B	5	0	0.2	0	P	0	P	P	0	P	P	P
		C	P	0	0.2	0	P	0	P	P	0	P	P	P
		D	P	P	0.1	0	0	0	P	P	0	0.2	P	P
		E			0	0	0	0	0	0	0	P	0	P
		F			0	P	0	0	P	P	P	0.2	0	0
		G			0	P	0	P	P	P	P	P	0	P
		H			P	P	P	P	P	P	0	P	P	P
		I			0	P	P	P	P	P	0	P	0	P
		J			P	0	P	P	P	P	0	0	0	0
3	6/17/2005	A	P	NR	P	NR	NR	P	P	NR	P	P	0	P
		B	6	NR	0	NR	P	NR	NR	NR	NR	P	P	P
		C	P	NR	0	NR	P	NR	P	NR	P	P	P	P
		D	P	P	0	NR	NR	NR	P	NR	NR	0	P	P
		E			0	NR	NR	NR	NR	NR	NR	P	NR	NR
		F			NR	P	NR	NR	P	P	P	0	NR	NR
		G			NR	P	NR	P	P	P	P	P	NR	NR
		H			P	P	P	P	P	P	NR	P	P	P
		I			NR	P	P	P	P	P	NR	P	P	NR
		J			P	NR	P	P	P	P	NR	0	0	NR
4	6/22/2005	A	P	NR	P	NR	0	NR	P	P	NR	P	P	0
		B	6	NR	0	NR	P	NR	P	NR	NR	P	P	P
		C	P	NR	0.1	NR	P	NR	P	P	NR	P	P	P
		D	P	P	0	NR	0	NR	P	P	NR	0	P	P
		E			0	NR	0	NR	NR	NR	NR	P	NR	NR
		F			NR	P	NR	NR	NR	P	P	0	NR	NR
		G			NR	P	NR	P	P	P	P	P	NR	NR
		H			P	P	P	P	P	P	NR	P	P	P
		I			NR	P	P	P	P	P	NR	P	P	NR
		J			P	NR	NR	P	P	P	NR	0	0	NR
5	6/29/2005	A	P	NR	P	NR	0	NR	P	P	NR	P	P	0
		B	9	NR	0	NR	P	NR	P	NR	NR	P	P	P
		C	P	NR	0	NR	P	NR	P	P	NR	P	P	P
		D	P	P	0	NR	0	NR	P	P	NR	0	P	P
		E			0	NR	0	NR	NR	NR	NR	P	NR	NR
		F			NR	P	NR	NR	NR	P	P	0	NR	NR
		G			NR	P	NR	P	P	P	P	P	NR	NR
		H			P	P	P	P	P	P	NR	P	P	P
		I			NR	P	NR	P	P	P	NR	P	P	NR
		J			P	NR	NR	P	P	P	NR	0	0	NR

Table 2: Vacuum Responses in Soil Vapor Monitoring Wells

WEEK	DATE	SAMPLE PROBE ID	VACUUM RESPONSES (<i>Magnahelic Gauges</i>)											
			SVW-10 in. H ₂ O	SVW-12 in. H ₂ O	SVW-15 in. H ₂ O	SVW-27 in. H ₂ O	SVW-28 in. H ₂ O	SVW-33 in. H ₂ O	SVW-34 in. H ₂ O	SVW-35 in. H ₂ O	SVW-36 in. H ₂ O	SVW-37 in. H ₂ O	SVW-38 in. H ₂ O	SVW-39 in. H ₂ O
6	7/7/2005	A	P	NR	P	0	0	P	P	0	P	P	0	
		B	5	0	0	0	P	0	P	0	0	P	P	P
		C	P	0	0	0	P	0	P	0	P	P	P	
		D	P	P	0	0	0	P	P	0	0	0.2	P	
		E			0	0	0	0	0	0	0	P	0	
		F			0	P	0	0	P	P	P	0.2	0	
		G			0	P	0	P	P	P	P	P	0	
		H			P	P	P	P	P	P	0	P	P	
		I			0	P	P	P	P	P	0	P	0	
		J			P	0	P	P	P	P	0	0	0	
7	7/15/2005	A	P	NR	P	NR	NR	P	P	NR	P	P	0	
		B	9	NR	NR	NR	P	NR	P	NR	NR	P	P	P
		C	P	NR	NR	NR	P	NR	P	NR	P	P	P	
		D	P	P	NR	NR	NR	P	P	NR	NR	NR	P	
		E			NR	P	NR							
		F			NR	P	NR	NR	P	P	P	NR	NR	
		G			NR	P	NR	P	P	P	P	P	NR	
		H			P	P	P	P	P	P	NR	P	P	
		I			NR	P	P	P	P	P	NR	P	P	
		J			P	NR	P	P	P	P	NR	NR	NR	
8	7/22/2005	A	P	NR	P	NR	NR	P	P	NR	P	P	0	
		B	8	NR	NR	NR	P	NR	P	NR	NR	P	P	P
		C	P	NR	NR	NR	P	NR	P	NR	P	P	P	
		D	P	P	NR	NR	NR	P	P	NR	NR	NR	P	
		E			NR	P	NR							
		F			NR	P	NR	NR	P	P	P	NR	NR	
		G			NR	P	NR	P	P	P	P	P	NR	
		H			P	P	P	P	P	P	NR	P	P	
		I			NR	P	P	P	P	P	NR	P	P	
		J			P	NR	P	P	P	P	NR	NR	NR	
9	7/29/2005	A	P	NR	P	NR	NR	P	P	NR	P	P	0	
		B	6	NR	NR	NR	P	NR	P	NR	NR	P	P	P
		C	P	NR	NR	NR	P	NR	P	NR	P	P	P	
		D	P	P	NR	NR	NR	P	P	NR	NR	NR	P	
		E			NR	P	NR							
		F			NR	P	NR	NR	P	P	P	NR	NR	
		G			NR	P	NR	P	P	P	P	P	NR	
		H			P	P	P	P	P	P	NR	P	P	
		I			NR	P	P	P	P	P	NR	P	P	
		J			P	NR	P	P	P	P	NR	NR	NR	

Table 2: Vacuum Responses in Soil Vapor Monitoring Wells

WEEK	DATE	SAMPLE PROBE ID	VACUUM RESPONSES (<i>Magnahelic Gauges</i>)											
			SVW-10 in. H ₂ O	SVW-12 in. H ₂ O	SVW-15 in. H ₂ O	SVW-27 in. H ₂ O	SVW-28 in. H ₂ O	SVW-33 in. H ₂ O	SVW-34 in. H ₂ O	SVW-35 in. H ₂ O	SVW-36 in. H ₂ O	SVW-37 in. H ₂ O	SVW-38 in. H ₂ O	SVW-39 in. H ₂ O
10	8/5/2005	A	P	NR	P	0.1	0	0	P	P	0	P	P	0
		B	10	0.5	NR	0	P	0.1	P	0	0	0.1	P	P
		C	P	0	NR	0.1	P	0	P	P	0	P	P	P
		D	P	P	NR	0	0	0	P	P	0	0.1	0	P
		E			NR	0	0	0	0	0	0	0	P	0
		F				0	P	0	0	P		P	0	0.3
		G				0	P	0.1	P	P		P	P	0
		H				P	P	P	P	P		0	P	P
		I				0.3	P	P	P	P		0	P	0
		J				P	0		P			0	0	0
11	8/12/2005	A	P	NR	P	0	NR	0	P	P	NR	P	P	0
		B	14	0	NR	0	P	0	P	NR	NR	0	P	P
		C	P	0	NR	0	P	0	P	P	NR	P	P	P
		D	P	P	NR	0	NR	0	P	P	NR	0	NR	P
		E			NR	0	NR	0	NR	NR	NR	0	P	0
		F				0	P	0	NR	P		P	NR	0.2
		G				0.6	P	0	P	P		P	P	0
		H				P	P	P	P	P		0	P	P
		I				0	P	P	P	P		0	P	0
		J				P	0		P			0.1	NR	
12	8/17/2005	A	P	NR	P	0	NR	0	P	P	NR	P	P	0
		B	18	0	NR	0	P	0	P	NR	NR	0	P	P
		C	P	0	NR	0	P	0	P	P	NR	P	P	P
		D	P	P	NR	0	NR	0	P	P	NR	0	NR	P
		E			NR	0	NR	0	NR	NR	NR	0	P	0
		F				0	P	0	NR	P		P	NR	0
		G				0	P	0	P	P		P	P	0
		H				P	P	P	P	P		0	P	P
		I				0	P	P	P	P		0	P	0
		J				P	0		P			0	NR	
13	8/24/2005	A	P	NR	P	0	NR	0	P	P	NR	P	P	0
		B	17	0	NR	0	P	0	P	NR	NR	0	P	P
		C	P	0	NR	0	P	0	P	P	NR	P	P	P
		D	P	P	NR	0	NR	0	P	P	NR	0	NR	P
		E				0	NR	0	NR	NR	NR	0	P	0
		F				0	P	0	NR	P		P	NR	0
		G				0	P	0	P	P		P	P	0
		H				P	P	P	P	P		0	P	P
		I				0	P	P	P	P		0	P	0
		J				P	0		P			0	NR	

Table 2: Vacuum Responses in Soil Vapor Monitoring Wells

WEEK	DATE	SAMPLE PROBE ID	VACUUM RESPONSES (<i>Magnahelic Gauges</i>)											
			SVW-10 <i>in. H₂O</i>	SVW-12 <i>in. H₂O</i>	SVW-15 <i>in. H₂O</i>	SVW-27 <i>in. H₂O</i>	SVW-28 <i>in. H₂O</i>	SVW-33 <i>in. H₂O</i>	SVW-34 <i>in. H₂O</i>	SVW-35 <i>in. H₂O</i>	SVW-36 <i>in. H₂O</i>	SVW-37 <i>in. H₂O</i>	SVW-38 <i>in. H₂O</i>	SVW-39 <i>in. H₂O</i>
14	8/31/2005	A	P	NR	P	0	0	P	P	0	P	P	0	
		B	16	0	0	0	P	0	P	0	0	P	P	
		C	P	0	0	0	P	0	P	0	P	P	P	
		D	P	P	0	0.3	0	0	P	P	0	0	P	
		E			0	0	0	0	0	0	0	P	0	
		F				0	P	0	0	P	P	0	0.2	
		G				0.5	P	0	P	P	P	P	0	
		H				P	P	P	P	P	0	P	P	
		I				0	P	P	P	P	0	P	0	
		J				P	0	P	P	P	0	0	0	
15	9/7/2005	A	P	NR	P	0	NR	NR	P	P	NR	P	P	0
		B	18	NR	NR	0	P	NR	P	NR	NR	NR	P	P
		C	P	NR	NR	0	P	NR	P	P	NR	P	P	P
		D	P	P	NR	0	NR	NR	P	P	NR	NR	NR	P
		E			NR	0	NR	NR	NR	NR	NR	NR	P	0
		F				0	P	NR	NR	P	P	P	NR	0
		G				0	P	NR	P	P	P	P	P	0
		H				P	P	P	P	P	P	NR	P	P
		I				0	P	NR	P	P	P	NR	P	0
		J				P					P	NR	NR	

Notes:

NR - No Reading

P - Plugged

Table 3: Summary of Laboratory Analytical Results

Week	Sample ID	Sample Location	Sample Matrix	Date Sampled	VOCs Using TO-14 ($\mu\text{g/L}$)												
					Dichlorodifluoromethane	Chloroethane	Freon 11	1,1-DCE	Freon 113	Chloroform	1,1,1-TCA	CCl ₄	TCE	Toluene	PCE	p&m-Xylene	Total VOCs
VE-03																	
1	VE03-A-001-001	Screen A	Air	6/3/2005	ND	0.055	0.012	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.944
	VE03-B-001-002	Screen B	Air	6/3/2005	ND	0.600	0.220	ND	ND	ND	ND	0.110	0.043	ND	ND	ND	32.385
	VE03-INN-001-003	Influent	Air	6/3/2005	ND	0.140	0.067	ND	ND	ND	ND	0.035	0.018	ND	ND	ND	4.136
	VE03-EFF-001-004	Effluent	Air	6/3/2005	0.055	0.320	0.049	ND	0.070	ND	ND	ND	ND	ND	ND	ND	13.924
2	VE03-A-002-005	Screen A	Air	6/6/2005	0.003	0.018	0.025	ND	ND	0.004	ND	0.003	0.007	0.004	0.005	ND	1.074
	VE03-A-002-005-Dup	Screen A	Air	6/6/2005	ND	0.018	0.025	ND	ND	0.005	ND	ND	0.006	0.004	0.005	ND	1.123
	VE03-B-002-006	Screen B	Air	6/6/2005	ND	0.390	0.680	ND	ND	ND	ND	ND	ND	ND	ND	ND	20.325
	VE03-INN-002-007	Influent	Air	6/6/2005	ND	0.110	0.260	ND	ND	0.015	ND	ND	0.030	ND	ND	ND	3.771
	VE03-EFF-002-008	Effluent	Air	6/6/2005	ND	0.120	0.063	ND	0.070	ND	ND	ND	ND	ND	ND	ND	9.110
	VE03-B-002-010	Screen B	Air	6/7/2005	ND	0.310	0.920	ND	ND	ND	ND	ND	ND	ND	ND	ND	16.739
	VE03-INN-002-011	Influent	Air	6/7/2005	ND	0.059	0.270	ND	ND	0.016	ND	0.014	0.028	ND	0.010	ND	2.220
	VE03-EFF-002-012	Effluent	Air	6/7/2005	ND	0.072	0.027	ND	0.033	ND	ND	ND	ND	ND	ND	ND	4.434
	VE03-A-002-013	Screen A	Air	6/8/2005	0.003	0.017	0.024	ND	ND	0.005	ND	ND	0.005	0.005	0.004	0.003	1.075
	VE03-B-002-014	Screen B	Air	6/8/2005	ND	0.590	0.710	ND	ND	0.052	ND	ND	0.056	ND	ND	ND	30.588
	VE03-INN-002-015	Influent	Air	6/8/2005	ND	0.210	0.290	ND	ND	0.026	ND	ND	0.034	ND	ND	ND	6.161
	VE03-EFF-002-016	Effluent	Air	6/8/2005	ND	0.220	0.071	ND	0.130	ND	ND	ND	ND	ND	ND	ND	12.956
4	VE03-A-004-017	Influent	Air	6/22/2005	0.003	0.018	0.099	ND	ND	0.013	ND	0.005	0.020	0.006	0.004	0.004	0.921
	VE03-EFF-004-018	Effluent	Air	6/22/2005	ND	0.053	0.055	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.990
6	VE03-A-006-019	Screen A/Influent	Air	7/6/2005	0.003	0.014	0.130	ND	ND	0.015	ND	0.006	0.028	0.008	0.004	0.008	0.894
	VE03-EFF-006-020	Effluent	Air	7/6/2005	ND	0.044	0.042	ND	ND	ND	ND	ND	0.006	0.007	ND	0.012	4.700
8	VE03-A-008-021	Screen A/Influent	Air	7/20/2005	0.004	0.006	0.170	ND	ND	0.015	ND	0.006	0.030	0.007	0.004	0.007	0.528
	VE03-EFF-008-022	Effluent	Air	7/20/2005	0.003	0.009	0.034	0.003	ND	ND	ND	ND	0.005	0.007	ND	0.007	1.375
	VE03-EFF-008-022-Dup	Effluent	Air	7/20/2005	0.003	0.009	0.035	0.003	0.005	ND	ND	0.006	0.007	ND	0.006	1.385	
9	VE03-B-009-023	Screen B/Influent	Air	7/29/2005	ND	0.560	2.500	ND	ND	0.150	ND	0.140	0.200	ND	ND	ND	42.111
	VE03-EFF-009-024	Effluent	Air	7/29/2005	ND	0.100	0.045	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.581

Table 3: Summary of Laboratory Analytical Results

Week	Sample ID	Sample Location	Sample Matrix	Date Sampled	VOCs Using TO-14 ($\mu\text{g/L}$)												
					Dichlorodifluoromethane	Chloroethane	Freon 11	1,1-DCE	Freon 113	Chloroform	1,1,1-TCA	CCl ₄	TCE	Toluene	PCE	p&m-Xylene	Total VOCs
10	VE03-B-010-025	Screen B/Influent	Air	8/1/2005	ND	0.092	1.100	ND	ND	0.097	ND	ND	0.170	ND	ND	ND	12.228
	VE03-EFF-010-026	Effluent	Air	8/1/2005	ND	0.005	0.024	0.002	ND	ND	ND	ND	0.004	0.010	ND	0.007	1.193
	VE03-B-010-027	Screen B/Influent	Air	8/2/2005	ND	0.250	1.100	ND	ND	ND	ND	ND	0.140	ND	ND	ND	17.330
	VE03-EFF-010-028	Effluent	Air	8/2/2005	ND	0.031	0.024	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.291
	VE03-B-010-029	Screen B/Influent	Air	8/3/2005	ND	0.260	1.100	ND	ND	0.087	ND	0.072	0.140	ND	ND	ND	17.750
	VE03-EFF-010-030	Effluent	Air	8/3/2005	ND	0.032	0.032	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.234
12	VE03-B-012-031	Screen B/Influent	Air	8/17/2005	ND	0.009	0.260	ND	ND	0.022	ND	0.019	0.031	0.035	ND	0.012	2.403
	VE03-EFF-012-032	Effluent	Air	8/17/2005	ND	0.032	0.018	ND	ND	ND	ND	ND	ND	0.011	ND	0.009	3.730
14	VE03-B-014-033	Screen B/Influent	Air	8/31/2005	ND	0.240	0.900	ND	ND	ND	ND	ND	ND	ND	ND	ND	17.540
	VE03-EFF-014-034	Effluent	Air	8/31/2005	ND	0.063	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.319
15	VE03-B-015-035	Screen B/Influent	Air	9/9/2005	ND	0.023	0.690	ND	ND	0.067	ND	0.074	0.097	0.0092	ND	0.0092	5.912
	VE03-EFF-015-036	Effluent	Air	9/9/2005	ND	0.038	ND	ND	ND	ND	ND	ND	ND	0.009	ND	0.007	4.157
	VE03-A-015-037	Screen A	Air	9/9/2005	0.0027	0.014	0.004	ND	ND	0.007	ND	0.0044	0.0041	0.009	ND	0.008	0.858

Notes:

ND - Non Detect

Table 4: Influent and Effluent Emission Rates - VE-03

VE-03 INFLUENT				VE-03 EFFLUENT			
	Concentration ($\mu\text{g/L}$)	Flow Rate (cfm)	Removal Rate (lb/day)	Concentration ($\mu\text{g/L}$)	Flow Rate (cfm)	Removal Rate (lb/day)	Destruction Efficiency (%)
6/3/05 (Week 1)							
Freon 113	0	346	0.0000	0.07	346	0.0022	-100%
CCl4	0.035	346	0.0011	0	346	0.0000	100%
TCE	0.019	346	0.0006	0	346	0.0000	100%
PCE	0	346	0.0000	0	346	0.0000	100%
Total VOCs	4.136	346	0.1285	13.924	346	0.4328	-237%
6/6/05 (Week 2)							
Freon 113	0	340	0.0000	0.07	340	0.0021	-100%
CCl4	0	340	0.0000	0	340	0.0000	100%
TCE	0.03	340	0.0009	0	340	0.0000	100%
PCE	0	340	0.0000	0	340	0.0000	100%
Total VOCs	3.771	340	0.1152	9.11	340	0.2782	-142%
6/7/05 (Week 2)							
Freon 113	0	330	0.0000	0.033	330	0.0010	-100%
CCl4	0.016	330	0.0005	0	330	0.0000	100%
TCE	0.028	330	0.0008	0	330	0.0000	100%
PCE	0.01	330	0.0003	0	330	0.0000	100%
Total VOCs	2.22	330	0.0658	4.434	330	0.1314	-100%
6/8/05 (Week 2)							
Freon 113	0	312	0.0000	0.13	312	0.0036	-100%
CCl4	0	312	0.0000	0	312	0.0000	100%
TCE	0.034	312	0.0010	0	312	0.0000	100%
PCE	0	312	0.0000	0	312	0.0000	100%
Total VOCs	6.161	312	0.1727	12.956	312	0.3631	-110%
6/22/05 (Week 4)							
Freon 113	0	341	0.0000	0	341	0.0000	100%
CCl4	0.0047	341	0.0001	0	341	0.0000	100%
TCE	0.02	341	0.0006	0	341	0.0000	100%
PCE	0.0043	341	0.0001	0	341	0.0000	100%
Total VOCs	0.921	341	0.0282	3.99	341	0.1222	-333%
7/6/05 (Week 6)							
Freon 113	0	335	0.0000	0	335	0.0000	100%
CCl4	0.0055	335	0.0002	0	335	0.0000	100%
TCE	0.028	335	0.0008	0.0057	335	0.0002	80%
PCE	0.0041	335	0.0001	0	335	0.0000	100%
Total VOCs	0.8935	335	0.0269	4.7	335	0.1414	-426%
7/20/05 (Week 8)							
Freon 113	ND	331	0.0000	0.0046	331	0.0001	100%
CCl4	0.006	331	0.0002	ND	331	0.0000	100%
TCE	0.03	331	0.0009	0.005	331	0.0001	83%
PCE	0.0039	331	0.0001	ND	331	0.0000	100%
Total VOCs	0.5283	331	0.0157	1.38	331	0.0410	-161%

Table 4: Influent and Effluent Emission Rates - VE-03

VE-03 INFLUENT				VE-03 EFFLUENT			
	Concentration ($\mu\text{g/L}$)	Flow Rate (cfm)	Removal Rate (lb/day)	Concentration ($\mu\text{g/L}$)	Flow Rate (cfm)	Removal Rate (lb/day)	Destruction Efficiency (%)
7/29/05 (Week 9)							
Freon 113	ND	302	0.0000	ND	302	0.0000	100%
CCl4	0.14	302	0.0038	ND	302	0.0000	100%
TCE	0.12	302	0.0033	ND	302	0.0000	100%
PCE	ND	302	0.0000	ND	302	0.0000	100%
Total VOCs	42.111	302	1.1424	7.581	302	0.2057	82%
8/1/05 (Week 10)							
Freon 113	ND	295	0.0000	ND	295	0.0000	100%
CCl4	ND	295	0.0000	ND	295	0.0000	100%
TCE	0.17	295	0.0045	0.004	295	0.0001	98%
PCE	ND	295	0.0000	ND	295	0.0000	100%
Total VOCs	12.228	295	0.3240	1.1925	295	0.0316	90%
8/2/05 (Week 10)							
Freon 113	ND	313	0.0000	ND	313	0.0000	100%
CCl4	ND	313	0.0000	ND	313	0.0000	100%
TCE	0.14	313	0.0039	ND	313	0.0000	100%
PCE	ND	313	0.0000	ND	313	0.0000	100%
Total VOCs	17.33	313	0.4872	3.291	313	0.0925	81%
8/3/05 (Week 10)							
Freon 113	ND	315	0.0000	ND	315	0.0000	100%
CCl4	0.072	315	0.0020	ND	315	0.0000	100%
TCE	0.14	315	0.0040	ND	315	0.0000	100%
PCE	ND	315	0.0000	ND	315	0.0000	100%
Total VOCs	17.75	315	0.5022	3.234	315	0.0915	82%
8/17/05 (Week 12)							
Freon 113	ND	274	0.0000	ND	274	0.0000	100%
CCl4	0.019	274	0.0005	ND	274	0.0000	100%
TCE	0.031	274	0.0008	ND	274	0.0000	100%
PCE	ND	274	0.0000	ND	274	0.0000	100%
Total VOCs	2.403	274	0.0591	3.73	274	0.0918	-55%
8/31/05 (Week 14)							
Freon 113	ND	315	0.0000	ND	315	0.0000	100%
CCl4	ND	315	0.0000	ND	315	0.0000	100%
TCE	ND	315	0.0000	ND	315	0.0000	100%
PCE	ND	315	0.0000	ND	315	0.0000	100%
Total VOCs	17.54	315	0.4963	4.319	315	0.1222	75%
9/9/05 (Week 15)							
Freon 113	ND	295	0.0000	ND	295	0.0000	100%
CCl4	0.074	295	0.0000	ND	295	0.0000	100%
TCE	0.097	295	0.0000	ND	295	0.0000	100%
PCE	ND	295	0.0000	ND	295	0.0000	100%
Total VOCs	5.912	295	0.1567	4.157	295	0.1102	30%

Table 5: Comparison of VE-03 Laboratory Data to VSLs

Sample Location	Depth ⁽¹⁾ (ft bgs)	Date ⁽²⁾	Concentration ($\mu\text{g/L}$)	Estimated DTW (ft bgs)	Leaching Depth (ft)	VSL ($\mu\text{g/L}$)	C/VSL
Carbon Tetrachloride							
Screen A	85	6/3/2005	ND	201	116.0	2.78	--
Screen B	159	6/3/2005	0.110	201	42.0	0.46	0.239
Influent	122	6/3/2005	0.035	201	79.0	1.57	0.022
Screen A	85	6/6/2005	0.003	201	116.0	2.78	0.001
Screen B	159	6/6/2005	ND	201	42.0	0.46	--
Influent	122	6/6/2005	ND	201	79.0	1.57	--
Screen B	159	6/7/2005	ND	201	42.0	0.46	--
Influent	122	6/7/2005	0.014	201	79.0	1.57	0.009
Screen A	85	6/8/2005	ND	201	116.0	2.78	--
Screen B	159	6/8/2005	ND	201	42.0	0.46	--
Influent	122	6/8/2005	ND	201	79.0	1.57	--
Screen A/ Influent	85	6/22/2005	0.005	201	116.0	2.78	0.002
Screen A/ Influent	85	7/6/2005	0.006	201	116.0	2.78	0.002
Screen A/ Influent	159	7/20/2005	0.006	201	42.0	2.78	0.002
Screen B/ Influent	159	7/29/2005	0.140	201	42.0	0.46	0.304
Screen B/ Influent	159	8/1/2005	ND	201	42.0	0.46	--
Screen B/ Influent	159	8/2/2005	ND	201	42.0	0.46	--
Screen B/ Influent	159	8/3/2005	0.072	201	42.0	0.46	0.157
Screen B/ Influent	159	8/17/2005	0.019	201	42.0	0.46	0.041
Screen B/ Influent	159	8/31/2005	ND	201	42.0	0.46	--
Screen B/ Influent	159	9/9/2005	0.074	201	42.0	0.46	0.161
Screen A	85	9/9/2005	0.004	201	116.0	2.78	0.002
TCE							
Screen A	85	6/3/2005	ND	201	116.0	9.92	--
Screen B	159	6/3/2005	0.043	201	42.0	1.3	0.033
Influent	122	6/3/2005	0.018	201	79.0	5.9	0.003
Screen A	85	6/6/2005	0.007	201	116.0	9.92	0.001
Screen B	159	6/6/2005	ND	201	42.0	1.3	--
Influent	122	6/6/2005	0.030	201	79.0	5.9	0.005
Screen B	159	6/7/2005	ND	201	42.0	1.3	--

Table 5: Comparison of VE-03 Laboratory Data to VSLs

Sample Location	Depth ⁽¹⁾ (ft bgs)	Date ⁽²⁾	Concentration (µg/L)	Estimated DTW (ft bgs)	Leaching Depth (ft)	VSL (µg/L)	C/VSL
TCE							
Influent	122	6/7/2005	0.028	201	79.0	5.9	0.005
Screen A	85	6/8/2005	0.005	201	116.0	9.92	0.000
Screen B	159	6/8/2005	0.056	201	42.0	1.3	0.043
Influent	122	6/8/2005	0.034	201	79.0	5.9	0.006
Screen A/ Influent	85	6/22/2005	0.020	201	116.0	9.92	0.002
Screen A/ Influent	85	7/6/2005	0.028	201	116.0	9.92	0.003
Screen A/ Influent	85	7/20/2005	0.030	201	116.0	9.92	0.003
Screen B/ Influent	159	7/29/2005	0.200	201	42.0	1.3	0.154
Screen B/ Influent	159	8/1/2005	0.170	201	42.0	1.3	0.131
Screen B/ Influent	159	8/2/2005	0.140	201	42.0	1.3	0.108
Screen B/ Influent	159	8/3/2005	0.140	201	42.0	1.3	0.108
Screen B/ Influent	159	8/17/2005	0.031	201	42.0	1.3	0.024
Screen B/ Influent	159	8/31/2005	ND	201	42.0	1.3	--
Screen B/ Influent	159	9/9/2005	0.097	201	42.0	1.3	0.075
Screen A	85	9/9/2005	0.004	201	116.0	9.92	0.000

(1) Sample depth assumed to be depth of bottom of screen for individual screen samples, or the average of the screen depths for the combined influent samples.

(2) VE-03 started on 6/3/05, Screen A only started on 6/17/05, Screen B only started on 7/29/05

Table 6: Comparison of CCl₄ Concentrations at Soil Vapor Monitoring Wells

Well	Pre-SVE Data		Final SVE Data		Post-SVE Data	
	Date	Conc. (µg/L)	Date	Conc. (µg/L)	Date	Conc. (µg/L)
25-85	Oct-98	83	Mar-99	14	Oct-05	ND
27-85	Oct-98	7.4	Apr-05	ND	Oct-05	ND
27-120	Oct-98	110	Apr-05	ND	Oct-05	ND
27-140	Oct-98	161	Apr-05	ND	Oct-05	ND
27-180	Oct-98	155	Jul-05	ND	Oct-05	1.3
27-205	Oct-98	429.5	Apr-05	ND	Oct-05	ND
28-80	Oct-98	22	Nov-04	ND	Oct-05	ND
28-105	Oct-98	210	Nov-04	ND	Oct-05	ND
32-180	Oct-98	117.5	Jul-05	ND	Oct-05	ND
32-195	Oct-98	88	Jul-05	ND	Oct-05	ND
33-40	Oct-98	12	Oct-04	ND	Oct-05	ND
33-60	Oct-98	89	Oct-04	ND	Oct-05	ND
33-85	Oct-98	140	Apr-05	ND	Oct-05	ND
33-105	Oct-98	197.5	Jul-05	ND	Oct-05	ND
33-120	Oct-98	141	Apr-05	ND	Oct-05	ND
33-140	Oct-98	179	Jul-05	ND	Oct-05	ND
33-200	Oct-98	77.5	Oct-04	ND	Oct-05	ND
34-65	Oct-98	4.5	Jul-01	ND	Oct-05	ND
34-80	Oct-98	6.1	Nov-04	ND	Oct-05	ND
34-95	Oct-98	28	Nov-04	ND	Oct-05	ND
35-80	Oct-98	19	Apr-05	ND	Oct-05	ND
35-155	Oct-98	61	Oct-99	13	Oct-05	ND
36-35	Oct-98	9.2	Apr-05	ND	Oct-05	ND
36-55	Oct-98	16.5	Apr-05	ND	Oct-05	ND
36-75	Oct-98	22	Apr-05	ND	Oct-05	ND
36-92	Oct-98	20	Apr-05	ND	Oct-05	ND
37-40	Oct-98	24	Apr-05	ND	Oct-05	ND
37-80	Oct-98	62	Apr-05	ND	Oct-05	ND
37-100	Oct-98	62	Apr-05	ND	Oct-05	ND
37-140	Oct-98	30	Jan-00	4.2	Oct-05	ND
37-155	Oct-98	26	Apr-05	ND	Oct-05	ND
37-170	Oct-98	23	Apr-05	ND	Oct-05	ND
37-185	Oct-98	12	Apr-05	ND	Oct-05	ND
38-80	Oct-98	13	Apr-05	ND	Oct-05	ND
38-110	Oct-98	13	Apr-05	ND	Oct-05	ND
38-170	Oct-98	23	Apr-05	ND	Oct-05	ND
39-85	Oct-98	3.8	Apr-05	ND	Oct-05	ND
39-100	Mar-99	1.2	Jul-05	ND	Oct-05	ND
39-110	Oct-98	9.8	Apr-05	ND	Oct-05	ND
39-130	Oct-98	6.2	Jul-05	ND	Oct-05	ND

Table 7: Comparison of TCE Concentrations at Soil Vapor Monitoring Wells

Well	Pre-SVE Data		Final SVE Data		Post-SVE Data	
	Date	Conc. ($\mu\text{g}/\text{L}$)	Date	Conc. ($\mu\text{g}/\text{L}$)	Date	Conc. ($\mu\text{g}/\text{L}$)
27-140	Oct-98	1.2	Apr-05	ND	Oct-05	ND
27-180	Oct-99	4.3	Jul-05	ND	Oct-05	ND
27-205	Mar-99	2.1	Apr-05	ND	Oct-05	ND
32-180	Oct-98	5.7	Jul-05	ND	Oct-05	ND
32-195	Oct-98	3.2	Jul-05	ND	Oct-05	ND
33-40	Oct-98	6.3	Oct-04	ND	Oct-05	ND
33-60	Oct-98	4.3	Oct-04	ND	Oct-05	ND
33-85	Oct-98	2.8	Apr-05	ND	Oct-05	ND
33-105	Oct-98	2.5	Jul-05	ND	Oct-05	ND
33-120	Oct-98	2.2	Apr-05	ND	Oct-05	ND
33-200	Oct-98	1.2	Oct-04	ND	Oct-05	ND
35-155	Oct-98	2.6	Oct-99	9	Oct-05	ND
36-35	Mar-99	18	Apr-05	ND	Oct-05	ND
36-55	Mar-99	2.9	Apr-05	ND	Oct-05	ND
36-75	Oct-99	2.2	Apr-05	ND	Oct-05	ND
36-92	Oct-99	1.4	Apr-05	ND	Oct-05	ND
37-40	Oct-98	1.2	Apr-05	ND	Oct-05	ND
37-80	Oct-98	2.4	Apr-05	ND	Oct-05	ND
37-100	Oct-98	3.5	Apr-05	ND	Oct-05	ND
37-140	Oct-98	4.5	Jan-00	ND	Oct-05	ND
37-155	Oct-98	2.3	Apr-05	ND	Oct-05	ND
37-170	Oct-98	3	Apr-05	ND	Oct-05	ND
37-185	Oct-98	2	Apr-05	ND	Oct-05	ND
38-80	Oct-98	1.9	Apr-05	ND	Oct-05	ND
38-110	Oct-98	1.4	Apr-05	ND	Oct-05	ND
38-170	Oct-98	3.2	Apr-05	ND	Oct-05	1.4
39-85	Oct-98	1.6	Apr-05	ND	Oct-05	ND
39-100	Mar-99	1.4	Jul-05	2.5	Oct-05	1.9
39-110	Oct-98	4.7	Apr-05	ND	Oct-05	ND
39-130	Oct-98	15	Jul-05	ND	Oct-05	ND

ND = Non-detect

Table 8: Summary of CCl₄ and TCE Mass Estimates

Date	CCl ₄ (lb)	TCE (lb)
1996-1998 (before SVE operation)	661.1	76.4
July 2001	10.2	38.4
May 2002	8.8	31.2
August 2003 – July 2004	13.1	35.4
October/November 2004	8.1	38.2
February 2004	8.1	32.7
April 2004	NA	31.7
July 2004	8.0	30.1
October/November 2005	8.0	29.7

NA – CCl₄ not detected at any monitoring location; therefore
a mass estimate was not calculated.